California Spotted Owl Module

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Introduction

Knowledge regarding the effects of fuels and vegetation management on California spotted owls (***Strix occidentalis occidentalis***)(CSOs) and their habitat is a primary information need for addressing conservation and management objectives in Sierra Nevada forests (Verner et al. 1992). Current fuels management concepts propose treatments at the landscape spatial scale, such as DFPZs and SPLATs, designed to modify fire behavior and facilitate suppression efforts. Resulting changes in vegetation structure and composition from treatments may affect CSOs and their habitat at multiple spatial and temporal scales. The goal of this module is to assess the effects of fuels and vegetation treatments on CSOs and important resources, such as vegetation and prey, that affect CSO distribution, abundance and population dynamics.

Habitat is operationally defined as the physical space occupied by an animal and the biotic and abiotic factors (e.g., resources) in that space (Morrison and Hall 2002). Habitat quality refers specifically to the ability of an area to provide conditions appropriate for individual and population persistence (Morrison and Hall 2002). Habitat selection is a hierarchical process by which an individual animal selects habitat to use at multiple scales. These scales range from the geographic range of a species, to use of an individual home range within the range, to use of vegetation patches within a home range, to use of specific resources (e.g., prey species, nest cavities) within vegetation patches (Johnson 1980). The multiple-scale nature of habitat selection indicates that the criteria for selection may be different at each scale, and that inferences garnered at each scale can have ramifications for understanding habitat relationships and subsequent development of management direction (Manly et al. 2002). Additionally, for species regulated by territorial behavior, including raptor species such as CSOs, population-level constraints can influence the density and distribution of individuals or breeding pairs, through territorial behavior and competition for space and resources. At the landscape-scale, raptor populations regulated by territorial behavior that are near carrying capacity exhibit a more-or-less regular distribution of territorial breeding pairs, with individual pair locations influenced by local habitat conditions, and landscape breeding density influenced by landscape distribution of habitat (Newton 1979).

The implications of habitat selection at the individual animal scale and of territorial regulation at the population level dictate that research seeking to understand landscape treatment effects should address habitat use and quality at the individual scale, as well as, population density and habitat relationships at the landscape-scale, to fully assess the effects of landscape fuels and vegetation management strategies. Current management direction is proposing landscape-scale treatment regimes to address fire and fuels issues, timber harvest, and vegetation restoration. It is necessary that research address management effects on CSOs at the appropriate scales at which management is being conducted. Proposed landscape treatments may have effects at either, or both, the individual territory or owl site scale as expressed through change in occupancy, diet, use of vegetation patches, survival or reproduction, or at the population level as expressed through change in the density or spatial distribution of territorial breeding pairs at the landscape-scale. The individual site scale and population level perspectives are complementary in that the population level provides context for interpreting change at the site scale. Most importantly, both perspectives are required by managers concerned with managing for high habitat quality sites, as well as, well-distributed, viable populations across landscapes while implementing management strategies to deal with large-scale fire and fuels issues.

Study Objectives

The CSO module is designed to provide information on treatment effects at the individual site and population level scales. The following objectives and questions will be addressed:

1) How do landscape-scale treatment regimes affect CSO density and habitat suitability at the landscape-scale?

2) How do fuels treatments and group selection harvest affect CSO occupancy, diet, reproduction, survival, and habitat fitness potential at the nest site, core area and home range scales?

3) How do fuels treatments and group selection affect diet, habitat use and home-range size and configuration?

Question 1: How do landscape-scale treatment regimes affect CSO density and habitat suitability at the landscape-scale?

Landscape vegetation patterns are a primary determinant of the density and distribution of spotted owls. Treatment regimes, along with natural disturbances, historical context and local conditions, are expected to result in differing landscape vegetation patterns across treatment units over time. Differences in vegetation patterns are expected to result in differences in the distribution, abundance, and quality of owl habitat at the landscape and home-range spatial scales. This question addresses owl population responses at the landscape scale and how owl density, distribution, population dynamics and habitat suitability are affected by the cumulative treatments and natural disturbances, and resultant landscape vegetation patterns. The general approach will have 2 major components: (1) monitor the number and location of territorial owl pairs and territorial singles over time within each treatment unit (TU) and (2) develop a habitat suitability model to assess how habitat suitability changes as a result of treatments. The approach will be adaptive and based on an iterative process of habitat model development, predictions of treatment effects on owl density and habitat suitability, monitoring of treatment effects and model predictions, revision of habitat model as necessary, followed by the next iteration of the process. The goal is to assess treatment effects on CSO populations and their habitat within a habitat modeling framework designed to improve understanding of wildlife habitat relationships and provide land managers with a tool to predict the effects of management actions on CSOs and their habitat.

CSO density will be estimated annually in each TU using extensive broadcast calling and intensive status surveys to determine owl CSO occupancy and social status. The target population is the territorial pairs and single individual CSOs within each TU. Each TU is mapped with polygons that conform to natural sub-watershed boundaries and are approximately the size of the core area of an individual owl pair. This size was used because it is large enough to potentially contain only one pair of owls. The sampling frame consists of the collection of polygons, with polygons functioning as the primary sample units (PSUs). Annual surveys will be conducted in each PSU with a combination of intensive status surveys and a maximum of 4 extensive broadcast call surveys. Survey effort will be explicitly documented and used to develop a function to account for probability of detection in the estimation of CSO occupancy and density over time. Mark-recapture techniques and reverse-time models will also be explored to estimate population growth rates, survival, and recruitment based on uniquely banded CSOs and to estimate trends in occupancy based on the polygon surveys within TUs and to compare these parameters across treatment regimes (Nichols 1992, Pradel 1996, Nichols et al. 2000). Our apriori expectation is that 12-20 owl pairs may occur in each treatment unit based on the size of the treatment units and currently available information on CSO density and distribution in the study area.

Habitat models will be developed using resource selection functions to predict CSO habitat suitability and population numbers (Manly et al 2002) across TUs and to project changes in habitat suitability resulting from treatments. Logistic regression will be used to compare CSO territory locations to available habitat at multiple scales to develop a statistical function for assessing habitat suitability. A priori models will be identified and an information theoretic approach will be used to identify the best models (Burnham and Anderson 1998). An iterative process of model development, field-testing of predictions, and model refinement will be used in adaptive framework to improve knowledge of CSO habitat relationships and project potential management effects.

Question 2: California spotted owl diet, survival, reproduction, and habitat fitness potential at nest-site, core area, and home-range scales.

Habitat patterns at within home-range scales affect owl occurrence and demographic responses. The objectives at the home-range scale are: (1) determine owl habitat-use patterns and habitat selection; and (2) determine if there are differences in habitat quality or habitat fitness potential (i.e., owl survival and reproduction) associated with variation in habitat patterns. Each of the above questions will be assessed hierarchically at the nest-site, core area, and home-range scales within each owl home-range, as stronger associations between owl occurrence, demographic responses and habitat occur at the nest-site and core areas spatial scales within home ranges (Lehmkuhl and Raphael 1993, North et al. 2000, Franklin et al. 2000).

Extensive broadcast surveys and status surveys will be used to locate all owl pairs within treatment units as described above under Question 1. Reproductive status will be determined each year at each territory and all owls will be banded with unique color-bands (Franklin et al 1996). Pellets and prey remains will be systematically collected at nest-sites and roosts to determine diets. Habitat at nest-sites (plot data) will be measured following a modified FIA protocol. Habitat at the core area and home-range scales will be assessed using aerial PI vegetation information. Habitat-use and selection patterns will be ascertained by comparing habitat at owl sites versus random or unoccupied sites using logistic regression models, classification and regression tree models, and an information-theoretic approach to model selection (Burnham and Anderson 1998). Habitat fitness potential, or habitat quality, will be assessed by relating survival and reproduction to habitat patterns and additional explanatory variables, such as weather, prey abundance, and seed production, using both a components-of-variation and model selection approach (e.g., Franklin et al. 2000) and a Bayesian belief network approach (D.C. Lee, pers. comm.). Annual variation in diet will be determined and related to habitat patterns at core area and home-range scales.

Question 3: Acute responses of California spotted owls to treatment effects within core areas and home-ranges.

In addition to the chronic responses addressed in Questions 1 and 2 above, owls may also exhibit short-term, acute behavioral responses to treatments. Acute responses may range from no effect, to shifts in use of prey species or space within home ranges to territory abandonment, or to reproductive failure or death during periods or seasons of treatment implementation. Changes over longer time periods following treatments may range from no effect to shifts in habitat use patterns and prey selection within home ranges to changes in habitat quality (survival and reproduction), which at the most extreme can result in home ranges that are no longer suitable for occupancy

The objectives of this question are to determine behavioral responses and home range configuration, habitat use, and prey use patterns of a subset of owl pairs to treatments within core areas of home ranges. Radio-telemetry will be used on an estimated total of approximately 30-40 pairs of owls across treatment units to determine how the above variables change before, during, and after treatments within core areas and home ranges. Plot-scale habitat information will be collected at foraging locations using the modified FIA protocol to provide fine-scale habitat use information. The specific pairs to be included in the study will be determined pending completion of: (1) initial CSO surveys conducted over the first years of the study under Question 1 that will provide an assessment of current owl distribution and abundance across the treatment units: (2) completion of the aerial PI vegetation coverage for the study area; and (3) finalization of treatment locations within treatment units. Each of these pieces of information is needed to determine current vegetation patterns within existing owl home ranges and how each home range will be treated. This information is required to identify suitable owl territories appropriate for inclusion in the telemetry study. Therefore, this module of the overall study plan will not be implemented until the second or third year of the study after a stronger informational base is available for specifying the details of the sampling design. The design of this module of the study will require extensive cooperation between managers and researchers in the design and timing of treatment implementation to meet basic study design objectives.

Specific Objectives 2003

Current information is lacking on the distribution and abundance of California spotted owls (CSOs) within the Plumas-Lassen Administrative Study (PLAS) area, with the majority of existing CSO records recorded during 1990-1992. Understanding the current distribution and abundance of CSOs is required to determine their status, establish baseline information, provide data for developing first-generation habitat models, and for refining the spatial allocation of treatments. Updated information on CSO distribution is also required to assess the current existing PAC network. Treatments will avoid Protected Activity Centers (PACs). Current information on existing vegetation conditions is necessary for developing first-generation habitat suitability models. Our specific objectives for 2002 were to establish survey polygon and survey point networks in the 11 Treatment Units (TU) and conduct initial owl inventory surveys in 5 of the 11 TUs, and contribute to the completion of a current vegetation map for the entire study area.

Results and Accomplishments - 2002

A team of 3 field project leaders was recruited in 2002 along with a seasonal field crew of 9 technicians. A network of survey polygons and survey points was established in TUs 1-5 in April–May 2002 and in TUs 6-11 during September-November 2002. Each network is designed to provide 100% survey coverage of a TU. The distribution of survey points was tailored to the local topography within each TU such that points were located at prominent locations, such as ridge points, to provide efficient coverage of the TU. Points were established along roads as a first option to minimize travel time and maximize survey efficiency. Off-road, hike-in points were established as necessary to provide survey coverage of road-less areas. Point locations were recorded with a GPS and entered into a GIS, and points are field marked with flagging and a uniquely numbered metal tag. A total of 3755 survey points have been established, ranging from 166-518 per TU (Table 1).

CSO surveys were conducted on US Forests Service lands within TUs 1-5 during 2002. Surveys in TU 2 and 5 were conducted by field crews from the Sierra Nevada Research Center, Pacific Southwest Research Station, Davis CA. Private contractors conducted surveys in TUs 1 (Steven Holmes Forestry), 3 (Merlin Biological), and 4 (Platy-Hill Resources). All surveys adhered to the Region 5 Spotted Owl Survey Protocol (1991). Extensive broadcast surveys were conducted six times at each survey point across the breeding period (April-August), unless owls were detected and follow-up status surveys determined territorial, pair and reproductive status. Extensive surveys were terminated in the vicinity of documented pairs to minimize disturbance. Individual surveys were 10-min in duration and consisted of alternately playing spotted owl calls and listening for the first 8 minutes and then listening for the final 2 minutes. Extensive surveys were conducted using CD players and broadcast callers to minimize potential variation in calling ability across a large number of observers. We used the spotted owl calls and call sequence recommended on the PNW survey-training tapes (Eric Forsman, PNW, pers. comm.).

A total of 11,311 extensive point surveys were conducted in 2002, resulting in 471 owl detections and confirmation of 41 pairs of owls (Table 1, Figures 1-x). Based on clusters of detections of male and female owls and locations of historic sites recorded in the California Department of Fish and Game database, we suspect an additional 1-5 pairs of owls may be located in each TU. Surveys did not begin until mid- to late-April in 2002 due to delayed project approval finalized at the end on January 2002 and subsequent start-up time constraints. Therefore not all surveys could be completed by June to conclusively determine reproductive and pair status to protocol at locations of all owls detected during extensive surveys. Surveys to be conducted in 2003 will be used to evaluate pair status and location of nests or main roosts at these additional sites.

Discussion

Our efforts in 2002 focused on updating baseline information on CSO distribution and abundance in a subset of the TUs. Existing information is 10-12 years old for most of study area outside of the region that overlaps with the Lassen demographic study in TUs 1 and 11. We documented 41 confirmed pairs and suspect there may be an additional 1-5 pairs per TU based on clusters of male and female detections. An additional year of survey work is required to develop a more accurate estimate of the baseline number and distribution of territorial pairs that occur in each TU. Comparison of our first year survey results with existing information in the CDFG database indicated that some of the original locations continued to be occupied by CSOs whereas there have also been changes in the spatial distribution of CSO nest sites and core areas compared to the previous existing information. These results emphasize the importance of collecting current baseline information for assessing current status, providing accurate data for management and conservation planning, and generating the base data required to develop empirical habitat relationship models.

Our a priori expectation is that territorial pairs of CSOs should be distributed in a somewhat regular distribution across each TU, assuming suitable habitat is available and well distributed. This population distributional pattern is characteristic of territorial raptor species that breed as solitary pairs with populations regulated by territorial behavior (Newton 1979). Although are results are preliminary based on only one year of survey work, our results suggest that CSOs are distributed in a pattern that is consistent with our a priori expectation. Confirmed pairs and clusters of detections (possible, unconfirmed pairs) appear to be regularly distributed over most of the TUs where suitable habitat is present. Surveys are needed on private lands within TUs to determine if apparent gaps in some areas are actually occupied by CSOs on private lands. A notable exception to the more or less continuous distributional pattern we observed was reported from the northwest portion of TU-4 where a of cluster male and female detections suggested presence of a single territory in an area where records for 5 pairs and 2 territorial singles are listed in the CDFG database. Apparently there have not been significant changes in the vegetation in this area between 1990-2002 (Gary Rotta, Plumas National Forest, pers. comm.). This is a priority survey area for PSW survey crews in 2003 to either confirm or refute the 2002 survey results suggesting a gap in CSO distribution. Our short-term survey results also need to be viewed in the context of longer-term population trends. Results from long-term demographic studies that include TU-1 indicate that owl populations have declined over the previous decade (Blakesley et al. 2001), although the magnitude of the decline and role of potentially interactive causative factors are uncertain.

Objectives - 2003

Priority objectives for 2003 are to conduct initial CSO surveys in TUs 6-11 and continue annual surveys in TUs 1-5 to document the distribution and abundance of CSOs across TUs and to locate nest sites or main roost sites to provide information for constructing habitat models. Color-banding of territorial CSOs will be initiated in 2003. The updated photo-interpreted vegetation cover will be available in 2003 and initial habitat models will be generated.

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Table 1. Summary of the number of survey points established, individual surveys conducted, number of California spotted owl detections and confirmed pairs during 2002, along with the historic number of territorial pairs recorded in the 2001 California Department of Fish and Game spotted owl database.

Treatment Unit	Number of Call Stations	Number of Surveys	Number of Owl Detections	Number of Confirmed Pairs	Number of CDFG Historic Pairs
1	518	2992	46	9	12
2	358	1706	151	8	12
3	344	2027	58	8	9
4	323	2783	97	8	11
5	321	1803	119	8	9
6	479	-[a]	-	-	18
7	387	-	-	-	14
8	324	-	-	-	11
9	276	-	-	-	12
10	259	-	-	-	8
11	166	-	-	-	11
Totals	**3755**	**11,311**	**471**	**41**	**127**

-[a] = indicates no work was conducted on this aspect of the study in the TU during 2002.

Figure 1. Distribution of California spotted owl pairs reported in the California Department of Fish and Game 2000 database and confirmed pairs based on 2002 surveys in the Plumas-Lassen Administrative study area.

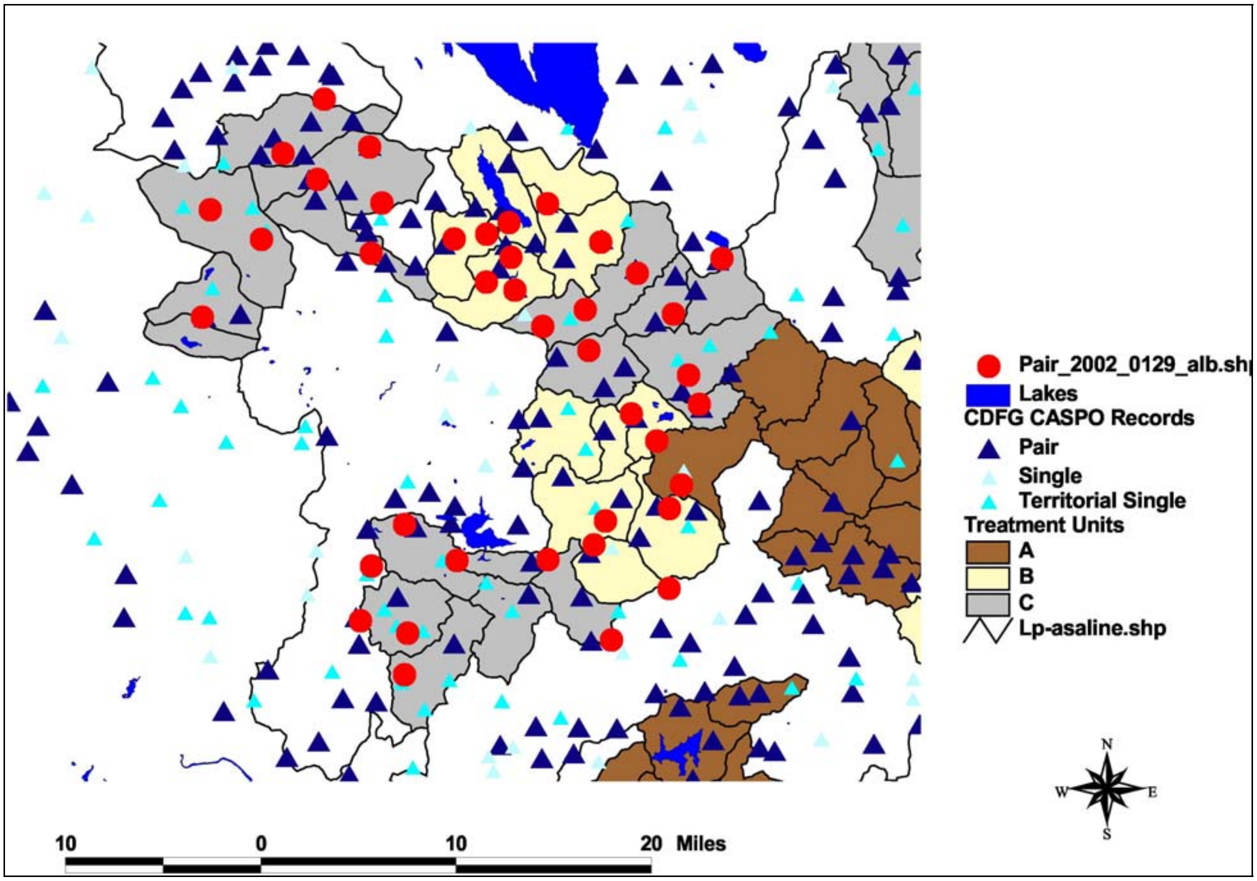


Figure 2. Distribution of California spotted owl pairs reported in the California Department of Fish and Game 2000 database and confirmed pairs and all owl detections in Treatment Unit 1 based on 2002 surveys in the Plumas-Lassen Administrative study area.

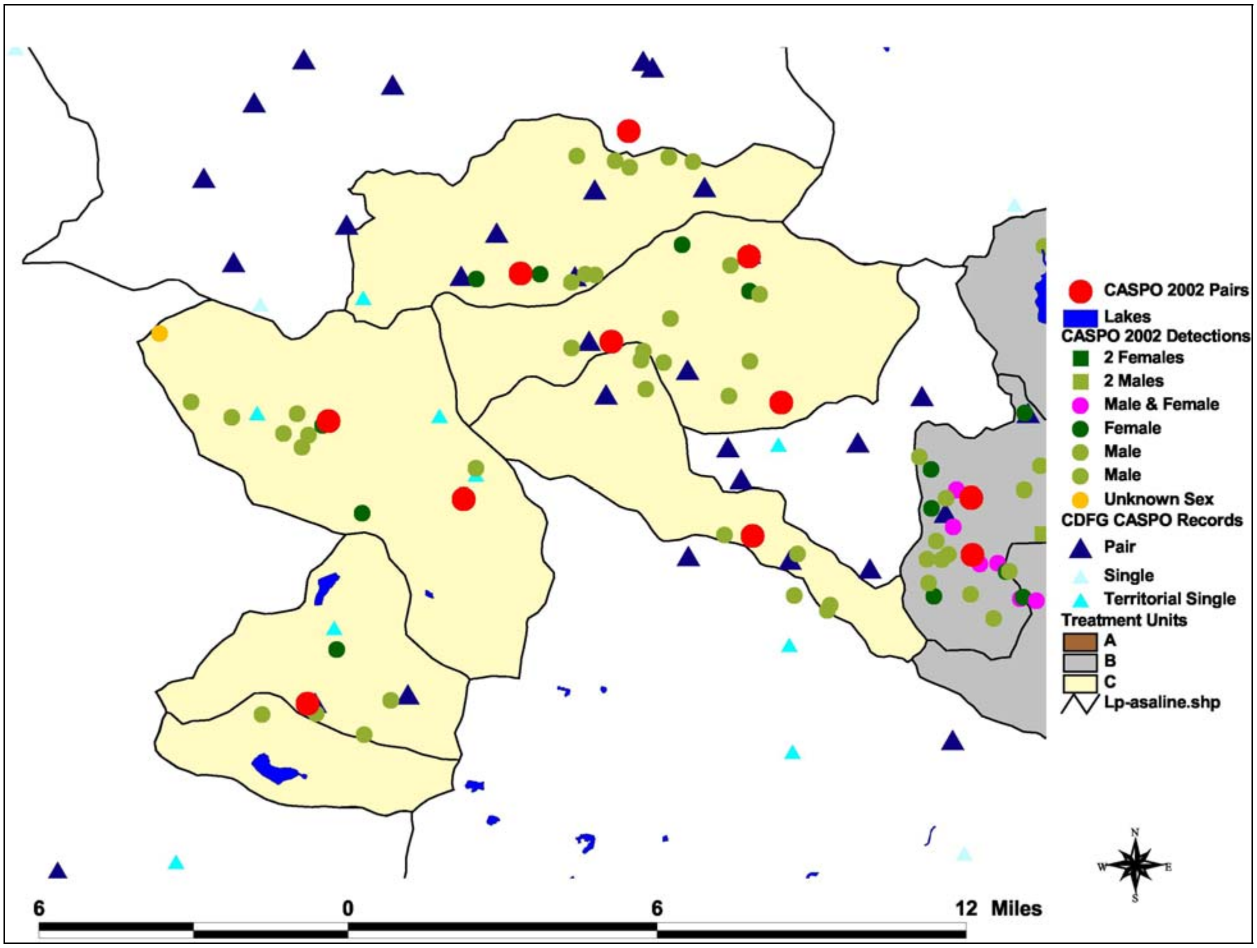


Figure 3. Distribution of California spotted owl pairs reported in the California Department of Fish and Game 2000 database and confirmed pairs and all owl detections in Treatment Unit 2 based on 2002 surveys in the Plumas-Lassen Administrative study area.

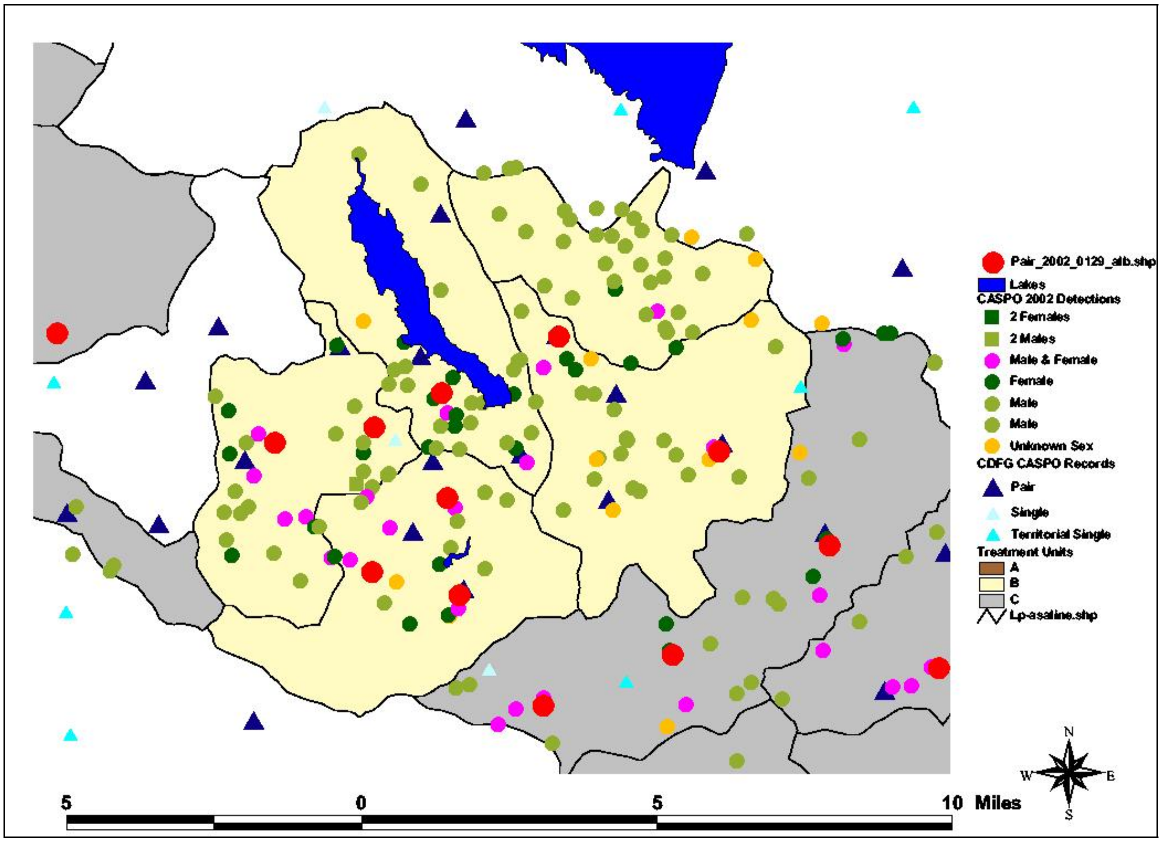


Figure 4. Distribution of California spotted owl pairs reported in the California Department of Fish and Game 2000 database and confirmed pairs and all owl detections in Treatment Unit 3 based on 2002 surveys in the Plumas-Lassen Administrative study area.

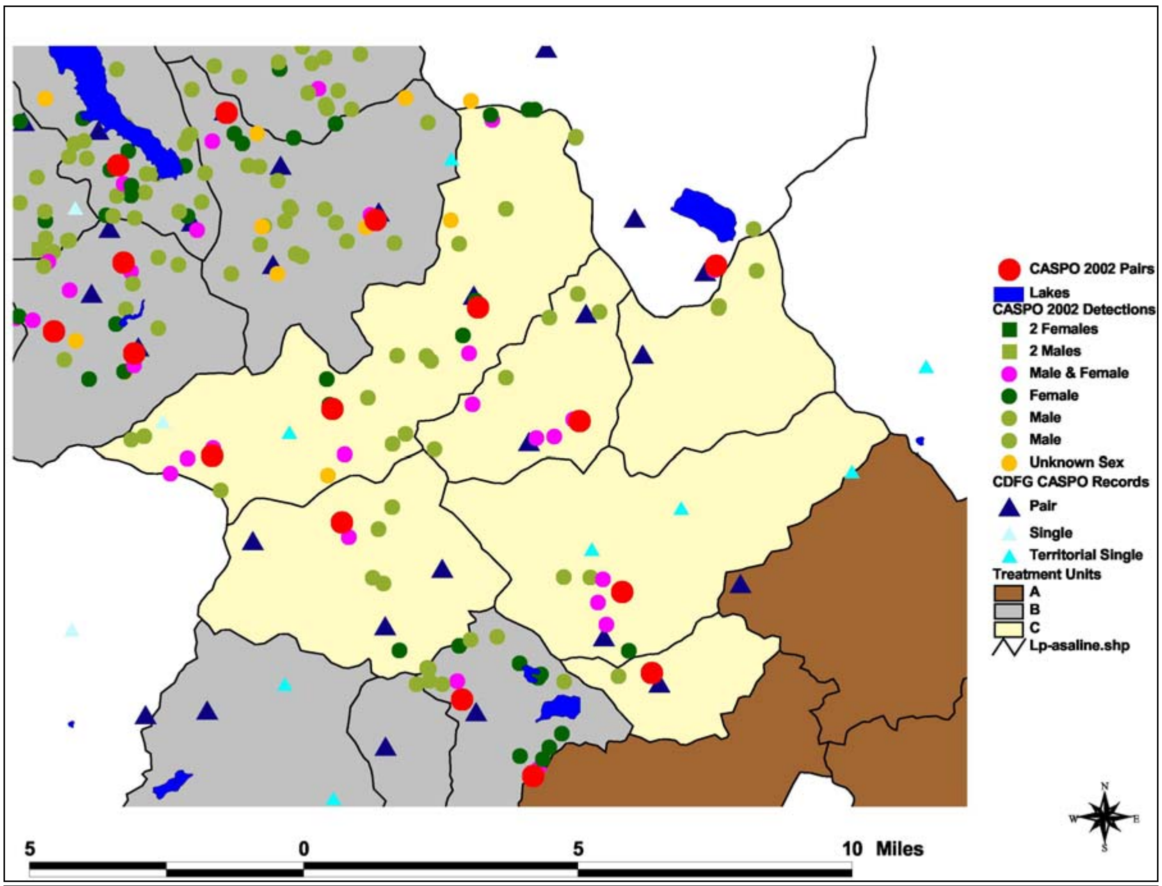


Figure 5. Distribution of California spotted owl pairs reported in the California Department of Fish and Game 2000 database and confirmed pairs and all owl detections in Treatment Unit 4 based on 2002 surveys in the Plumas-Lassen Administrative study area.

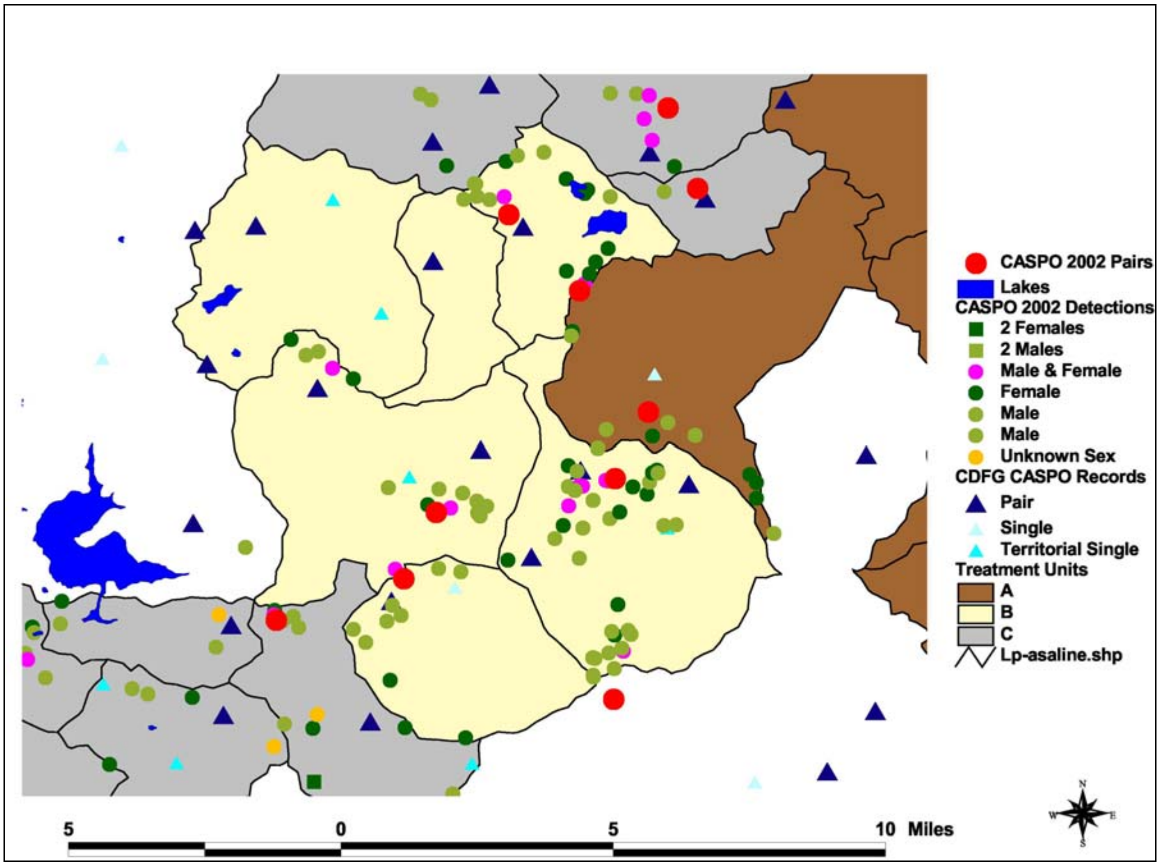
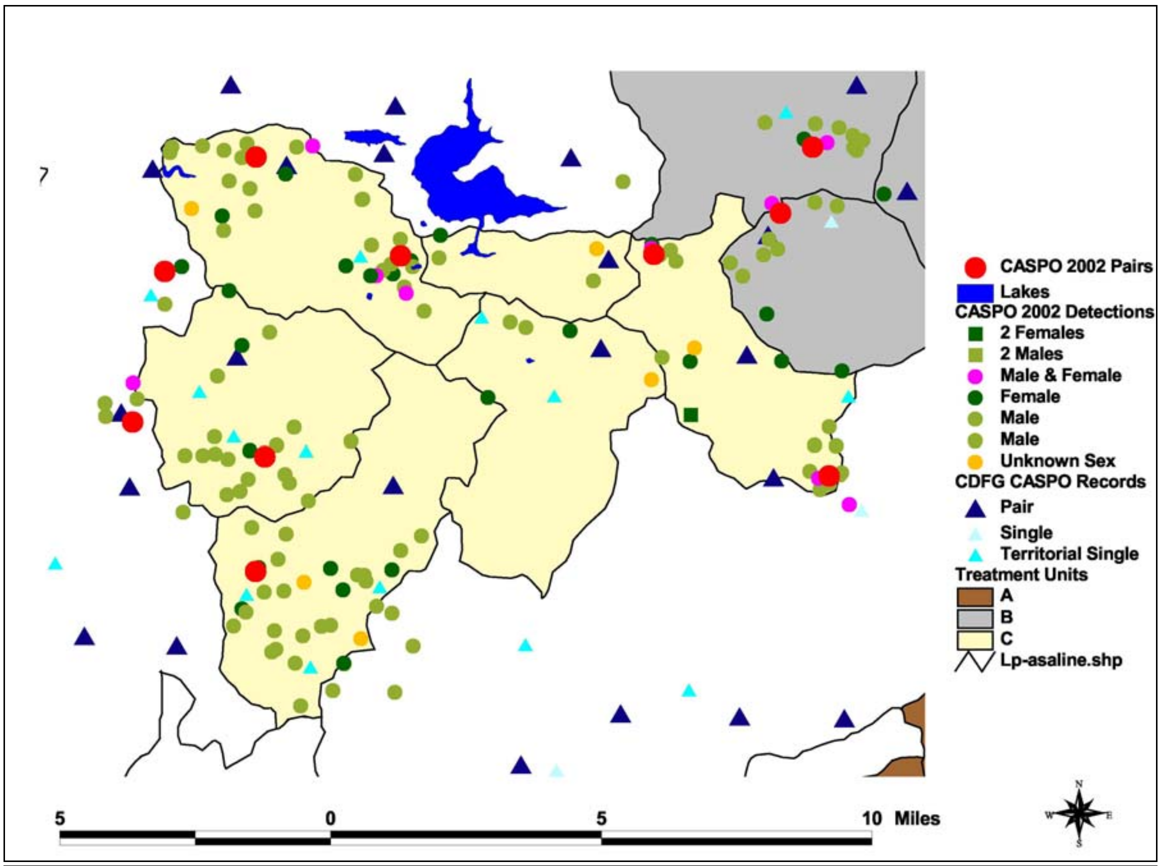


Figure 6. Distribution of California spotted owl pairs reported in the California Department of Fish and Game 2000 database and confirmed pairs and all owl detections in Treatment Unit 5 based on 2002 surveys in the Plumas-Lassen Administrative study area.



Coordination with National Forest System Staff

This project requires constant and careful collaboration with National Forest System (NFS) staff. There are many reasons this is required, including:

- Research is oriented towards management questions
- Vegetation treatments are planned in conjunction with research staff
- Treatments are executed by NFS
- Research work is done on Ranger Districts
- Safety of employees in the field is a shared concern

This project represents a program of unprecedented geographic magnitude and thus coordination is especially important. Success is dependent on effective cooperation and understanding of the respective roles of the parties. Thus many people involved in this project have worked hard to accomplish this coordination.

Intra-Agency Agreement

The Pacific Southwest Region (REGION) and the Pacific Southwest Research Station (PSW) have developed an Intra-Agency Agreement to jointly develop and fund the study. This agreement was signed by the Regional Forester and the Station Director in April of 2002. This agreement lays the foundation for the close cooperation and collaboration between Region 5 (including the Lassen and Plumas National Forest staffs) and PSW (in particular the scientists and support staff of the Sierra Nevada Research Unit). The agreement establishes a commitment for up to twenty years to complete the objectives of this study.

QLG Steering Committee

Although the Plumas Lassen Study is not directly related to the HFQLG Pilot Project, the QLG Steering Committee has been an effective forum in which to coordinate with key individuals from the Plumas and Lassen National Forests. In particular the Forest Supervisors meet with PSW Research personnel regularly to stay in touch with study design and implementation issues. Other key personnel, including the HFQLG Pilot Project coordinator and his staff are consulted regularly regarding study issues.

Plumas Lassen Study Team

The Plumas Lassen Study Team is comprised of Principal Investigators for all five research modules, research support staff, and project coordinators from the Plumas and/or Lassen Natioanl Forests. The Study Coordinator provides liaison to National Forest managers and staff, coordinates National Forest activities related to Regional responsibilities, participates in annual reviews and provide for participation by other relevant National Forest staff in these reviews, and facilitates review of study design leading to concurrence from NFS decision-makers. We have had approximately 20 meetings since the inception of the project and coordination has been excellent.

District Rangers/Plumas Lassen Study Team

All parties agreed that perhaps the most crucial coordination required for this project was the coordination in the field. This study involves extensive field work and deployment of field personnel who will be moving about the Ranger Districts from March through November each year. As many as 40 permanent, term, temporary, and university/collaborator staff will be in the field almost every day during much of this time period. Furthermore, the assistance of District staff; biologists, fuels specialists, etc. and the support of the District Rangers is vital to the ultimate success of the study.

In furtherance of the objective of close coordination with District staff we have initiated periodic meetings between Study scientists and their staff with District Rangers and their staff. All four participating District Rangers have participated as well as selected staff, depending on the topic. We have had five meetings over the last 12 months and covered a range of topics including:

- Research objectives/specific study strategies for each of the five modules
- Safety policy and procedures
- Communication strategy
- Logistics of working in the field on the Districts
- Housing for field crews
- EIS development and placement of treatments

These meetings have been very valuable and productive and we plan to continue them on an as needed basis.